Ridge Augmentation Vol 1.

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Horizontal bone-augmentation Procedure

1. TN Chiapasco M, Casentini P. Horizontal bone-augmentation procedures in implant dentistry: prosthetically guided regeneration. Periodontol 2000. 2018 Jun;77(1):213-240.

Need for ridge augmentation and limitations

2. ES Spray JR, Black CG, Morris HF, Ochi S. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. Ann Periodontol. 2000 Dec;5(1):119-28.
3. BT Monje A. The Critical Peri-implant Buccal Bone Wall Thickness Revisited: An Experimental Study in the Beagle Dog. Int J Oral Maxillofac Implants 2019 November/December;34(6):1328–1336.
4. AK Quirynen M, Lahoud P, Teughels W, Cortellini S, Dhondt R, Jacobs R, Temmerman A. Individual "alveolar phenotype" limits dimensions of lateral bone augmentation. J Clin Periodontol. 2022 Dec 27. doi: 10.1111/jcpe.13764.
5. TV Elnayef B, Porta C, Suárez-López Del Amo F, Mordini L, Gargallo-Albiol J, Hernández-Alfaro F. The Fate of Lateral Ridge Augmentation: A Systematic Review and Meta-Analysis. Int J Oral Maxillofac Implants. 2018 May/Jun;33(3):622-635. doi: 10.11607/jomi.6290. PMID: 29763500.
6. DL Jiang X, Zhang Y, Di P, Lin Y. Hard tissue volume stability of guided bone regeneration during the healing stage in the anterior maxilla: A clinical and radiographic study. Clin Implant Dent Relat Res. 2018 Feb;20(1):68-75. doi: 10.1111/cid.12570. Epub 2017 Dec 28. PMID: 29283207.

Flap Management and Anatomy

7. CM Ronda M, Stacchi C. A Novel Approach for the Coronal Advancement of the Buccal Flap. Int J Periodontics Restorative Dent. 2015 Nov-Dec;35(6):795-801.
8. VX Ronda M, Stacchi C. Management of a coronally advanced lingual flap in regenerative osseous surgery: a case series introducing a novel technique Int J Periodontics Restorative Dent. 2011 Sep-Oct;31(5):505-13.
9. TN Urban I, Traxler H, Romero-Bustillos M, Farkasdi S, Bartee B, Baksa G, Avila-Ortiz G. Effectiveness of Two Different Lingual Flap Advancing Techniques for Vertical Bone Augmentation in the Posterior Mandible: A Comparative, Split-Mouth Cadaver Study. Int J Periodontics Restorative Dent. 2018 Jan/Feb;38(1):35-40.
10. ES Urban IA, Monje A, Wang HL, Lozada J, Gerber G, Baksa G. Mandibular regional anatomical landmarks and clinical implications for ridge augmentation. Int J Periodontics Restorative Dent 2017;37: 347–353.
11. BT De Stavola L, Tunkel J, Fincato A, Fistarol F. The Vestibular Shifted Flap Design for Vertical Bone Augmentation in the Maxilla: Case Report and Technical Notes. Int J Periodontics Restorative Dent. 2021 May-Jun;41(3):367-373. doi: 10.11607/prd.4471. PMID: 34076633.
12. AK Urban IA, Saleh MHA, Serroni M, Shahbazi A, Baksa G, Szoke P, Ravid A Management of the Lingual Flap During Vertical Augmentation of the Atrophic Anterior Mandible: Anatomical Overview and Description of the Technique. .Int J Periodontics Restorative Dent. 2024;44(1):17-25. doi: 10.11607/prd.6667.
13. TV Shahbazi A, Windisch P, Tubbs RS, Decater T, Urbán IA, Baksa G, Iwanaga J.I The Clinical Relevance of the Lingual Branch in Ridge Augmentation of the Posterior Mandible: A Pilot Cadaver Study. Int J Periodontics Restorative Dent. 2024 Mar 20;44(2):213-218.

Horizontal bone-augmentation Procedure

Topic: Horizontal bone augmentation procedure
Authors: Chiapasco M, Casentini P
Title: Horizontal bone-augmentation procedures in implant dentistry: prosthetically guided regeneration.
Source: Periodontol 2000. 2018 Jun;77(1):213-240.
DOI: 10.1111/prd.12219.
Type: Review
Reviewer: Trisha Nguyen-Luu
Keywords: Horizontal bone augmentation, prosthetically guided regeneration,
Background:

- Restoration-driven implant placement: implant is placed in a position that allows for functonal and esthetic prosthesis that integrate with the adjacent natural dentition
- Bone or soft tissue augmentation is required when adequate bone + optimal soft tissue conditions are deficient.

Purpose: To present an evidence based + prosthetically driven approach for treatment of edentulous ridges with horizontal defects with implants and augmentation procedures.
Discussion:
Diagnostic protocol for partially dentate patient:

- Exclusion of local + general contraindications: increased tx complexity corresponds with a higher incident of complications in pts with compromised health
- Examination of esthetic. + functional needs of patient
- Preliminary clinical + radiographic examination: determine occlusal pattern, presence of ridge defect, bony pathology
- Evaluation of prosthetic feasibility: good match btw position of implant + future implant supported restoration
    - Mounted paster cast + diagnostic wax up are critical
- Evaluation of surgical feasibility + planning of ride augmentation procedures
    - Bone volume compatible with the prosthetically drive implant placement vs. Requires ridge augmentation
    - Use diagnostic template to simulate ideal axis for planned implant
- Classification of bone defects
    - Class I: no discrepancy exists btw ideal position of implant, implant prosthetic units + alveolar bone anatomy
        - No bone augmentation required
        - Implant placed directly into residual bone guided by surgical template
        - Implant completely surrounded with >1.5-2 mm on every surface
        - CTG recommended if cosmetic defect present to improve final esthetic result

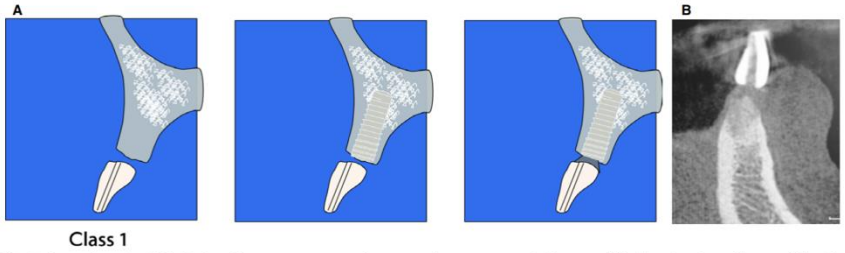


Fig. 6. In a class 1 clinical situation no augmentation procedures are needed to modify the alveolar ridge profile: the implant can be inserted in an ideal, prosthetically driven position and it will be completely embedded in the residual alveolar bone (A, B).

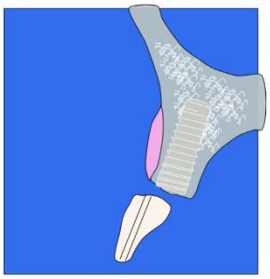


Fig. 7. In a class 1 clinical situation a connective tissue graft (CTG) can be indicated to correct a cosmetic defect.

    - Class 2: moderate horizontal deficit present
        - Implants can be placed in the correct prosthetically driven position but a simultaneous hard tissue augmentation sx is required
            - Fenestration or dehiscence of buccal plate with implant site prep
            - Thickness of residual buccal bony wall < 1 mm
        - Tx: implant placement + GBR (autogenous/ alloplastic bone particulate with membrane)
            - sagittal osteotomy techniques / osteotomes for ridge expansion

- Reduced diameter implants
- CTG

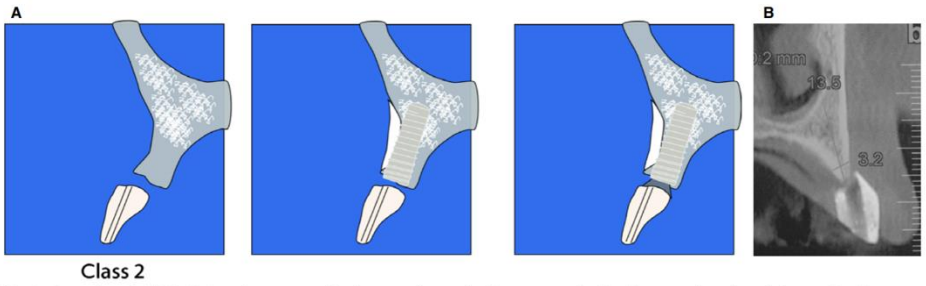


Fig. 9. In a class 2 clinical situation, a certain degree of atrophy is present: the implant can be placed, but a simultaneous bone-augmentation technique is needed (A, B).

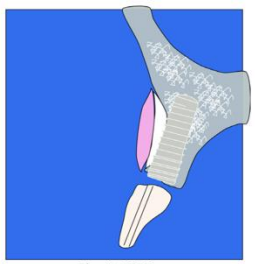


Fig. 11. In Class 2 clinical situations, implant placement and bone-augmentation procedures can be combined with a soft-tissue graft (connective tissue graft [CTG]), to improve the shape of the recipient site.

- Class 3: significant horizontal deficit + residual bony anatomy does not allow the implant to be placed in an ideal prosthetic position + achieve primary stability
  - Wait 4- 9 months after ridge augmentation before implant placement
  - Tx: GBR
    - Autogenous/nonautogenous bone block
    - Choice of different technique is related to local defect morphology + surgeon's preference
    - Reduce diameter implant to avoid more aggressive implant site preparation in reconstructed area
    - Use of diagnostic template during bone augmentation is recommended + same template for 2nd stage implant

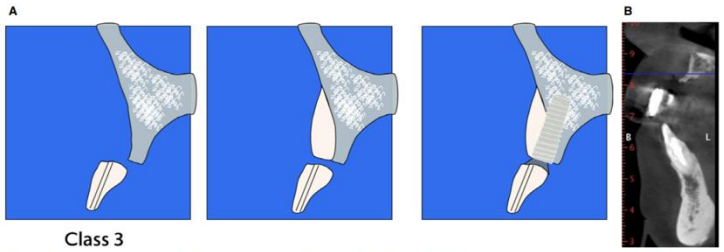


Fig. 13. In class 3 clinical situations, the greater degree of alveolar atrophy prevents implant placement. Implants are placed with a delayed approach following bone-augmentation procedures and adequate healing (A, B). B, buccal; L, lingual.

- Class 4: combined horizontal + vertical defect present
  - Wax up of longer clinical crowns + bulk of pink wax --> presence of vertical bone defect
  - TX: horizontal ridge augmentation + pink ceramic with correct clinical crown length
    - Horizontal + vertical augmentation – high risk of complication + surgically demanding (Early graft exposure, infection, resorption, increased morbidity)
    - Autogenous bone block
    - GBR
    - Le Fort I osteotomy with advancement + lowering of maxilla
    - Interpositional bone graft (only for severe atrophy of maxilla associated with increased interarch distance + maxillary retrusion

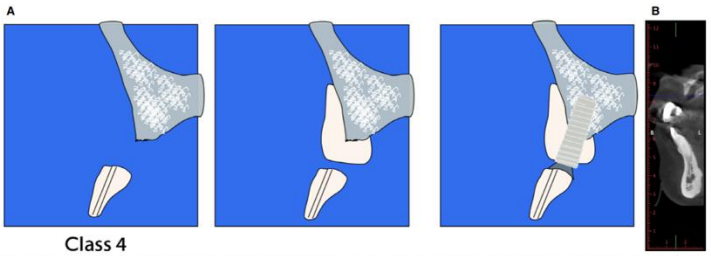


Fig. 16. In class 4 clinical situations, the horizontal alveolar atrophy is combined with vertical atrophy. It is not possible to insert implants in the correct three-dimensional position. As in class 3 cases, implants will be placed with a delayed approach following bone augmentation and healing (A, B). B, buccal; L, lingual.

- Selection criteria for different Classes:
  - **GBR + Resorbable membrane:**
    - Indications: treat small dehiscence/ fenestration Class 2 / small Class 3
    - Benefit: low degree of surgical skill , local anestheisa
      - Limited complications + easily managed with local CHX
    - Limitation: not for vertical defects (class 4)
    - Recommendations:
      - Multilayer resorbable membrane recommended to prolong barrier effect
      - Decortications – increase migration of osteogenic cells + accelerate revascularization of graft
      - Cover implant surface with autogenous bone + layer with osteoconductive bone substitute (DBBM) with overcorrection
      - Tension free closure with periosteal release
      - Modify prostheses to protect area from pressure
  - **GBR + Non-resorbable membranes (e-PTFE reinforced with Ti or Ti mesh)**
    - Indications: severe alveolar bone defects Class 3 + 4 cases
      - Sig significant horizontal and or vertical defects
      - Irregular shaped defect + difficult to adapt autogenous bone block
    - Benefit: greater stiffness + longer barrier effect
    - Limitation: higher rate of membrane exposure + partial/ total failure of augmentation procedure (btw 10-20%)
      - Must remove membrane if exposed
      - Need to harvest bone – increase surgical complications + post-op morbidity
      - Not supported by literature for fully edentulous patients
    - Recommendations:
      - Mixed autogenous particular + bone substitute
      - Perforate cortical plate
      - Use sterile paper to make a template before trimming membrane
      - Immobilize with Ti pins or microwscrews
      - Tenting screws
      - Partial fix before filling the defect with bone graft
      - Min. Distance of 1.5 mm btw membrane edge + roots of adjacent tooth
        - Gingival sulcus is a source of contamination during healing
      - Remove sharp edge of Ti mech to reduce risk of soft tissue dehiscence
      - Barrier removal + Implant placement 6-9 months
  - **Crest Splitting + Expansion Techniques**
    - Indications: moderate horizontal max. atrophy (Class 2)
    - Benefits: Low morbidity post-op, reduced cost
    - Limitations: rarely for the mandible b/w the presence of a lyaer of cancellous bone btw the 2 cortical plates is crucial
      - Contraindicated for buccal inclination – splitting increases buccal inclination of implants simultanously inserted
      - Technique sensitive – risk of fracture + unpredictable resorption of buccal cortical layer

- Recommendations:
    - Min flap elevation to reduce risk of resorption of split buccal bone
    - Piezo or thin cutting disk for mid-crestal bone cut first and then mesial + distal releasing bone cuts
    - Use chisel, expansion screws/ devices for sagittal split
    - But needs to be kept in contact with palatal wall of sagittal osteotomy to avoid buccal inclination
    - Use conical impalnt b/c expansion techniques create a conical cavity

- **Autogenous Bone Block Grafts**
    - Indications: sig. horizontal and or vertical alveolar bone defect – Class 3 + 4
        - Best scientifically documented technique esp for completely edentulous arch
    - Histology: osteoclastic degradation + osteoblastic substitution led to healing and integration of graft
        - Space btw graft and recipeint site is primarily filled with new woven cancellous bone
        - New bone tissue grows via formation of cutting cones (tunnels connecting native bone + Graft)
        - Cutting cones: filled with concentric layers of lamellar bone form the bases for the formation of osteons or harversian system
        - Grafted bone is completely replaced with osteons over several years
        - 4-6 months there is sufficient integration + revascularization of graft for implant placement
    - Benefit: lower complications rate than GBR + non-resorbable membranes
        - Can use extraoral bony sites
    - Limitations: contraindicated with defect has irregular shape + size
        - Increase pt morbidity + required GA or deep sedation
    - Recommendations:
        - Measure dimensions of recipient site before harvesting + facilitate surgical modeling of graft before fixation
        - Cortical perforations
        - Harvest graft from mand. ramus
        - Osteotomies in the donor site using piezosurgical instruments
        - Detact bone block by rotated a chisel in the osteotomy lines
        - Harvest autogenous bone chils from same site to fill gap btw recipient and bone block
        - Precise adaption + intimate contact with recipient site to facilitate migration of osteogenic cells + guarantee integration fo graft
        - Immobilize bone block with hemostatic clamp or Luniatschek graft holder + perforations of fixation screw is completed
        - 1.5 mm diameter fixation screw is screwed through bone block + into recipient site allowing for gentle compression of graft
        - Use min. Amount of screw required to immobilize graft confidently
        - Fill gap btw bone blokc + native bone with autogenous particular bone
        - Remove sharp edged of bone
        - <u>Cover</u> (not in the gap) bone block with DBBM
        - Cover site with resorbable membrane – prevent potential partial bone resorption
        - Place implant 4-6 months dependening on donor site
            - Iliac crest: 4 months – shorter b/c it is mainly cancellous bone + undergoes faster integration
            - Mandibular ramus, chin, calvarium: 6 months
        - Usually results in high bone density
            - Implants should not have excessive torque – may damage bone graft due to reduced vascularity or detach graft from recipient

site
        - Don't use wider diameters implant
    - **Le Fort I Osteotomy with interpositional bone grafts (inlay nasal + max sinus graft)**
        - Indications: severe atrophy of edentulous maxilla Class VI (Cawood + Howell Classification) - maxilla appears retruded compared to mand.
            - Residual ridge may present not only insufficent bone volume to host implants but also unfavorable vertical, transverse + saggittal interarch relationship
            - Pneumatized sinus
            - Le Fort I osteotomy: Allow for forward + downward repositioning of maxilla simultaneously correcting intermaxillary vertical, anterior-posterior + transverse discrepancies
            - Interpositional bone graft: inlay nasal + max sinus graft allow enough bone volume augmentation for implant placement
        - Benefits: allows correction of severe intermaxillary discrepancy + extreme atrophic edentulous maxilla
            - Improve facial + peri-oral soft tissue support
        - Limitations: severe post-op morbidity, temporary gait / ambulation problems, longer surgical time, GA
        - Recommendations:
            - Required nasotracheal intubation
            - Harvest bicortical bone block from anterior iliac crest for the anterior + posterior maxilla
            - Midcrestal incison from molar to molar + FTF to expose whole maxilla
            - Subperiosteal dissection of nasal mucosa + expose pterygoid maxillary suture
            - Le Fort 1 osteotomy performed using saws + piezo + chisels to bring downward + forward maxilla
            - Autogenous bone blocks are cut into pieces that fit into anterior + lateral parts of the down-fracture nasal floor + maxillary sinuses
            - 2 bone blocks as interpositional grafts for the posterior maxilla + 1 bone block for the anterior maxilla
            - Stabilize maxilla + bone blocks with Ti- plates + Screws + fill all remaining spaces with particular iliac bone
            - Implants placed in 6months

Need for ridge augmentation and limitations

Topic: facial bone thickness
Authors: Spray JR, Black CG, Morris HF, Ochi S
Title: The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering
Source: Ann Periodontol. 2000 Dec;5(1):119-28
DOI: 10.1902/annals.2000.5.1.119
Type: clinical
Reviewer: Erin Schwoegl
Keywords: dental implants; alveolar bone loss; hydroxyapatite/therapeutic use; follow-up studies; vertical dimension; facial bones.

Purpose: To evaluate the relationship of facial bone thickness and bone loss in order to identify a “critical thickness” at which no change occurs

Material and methods:
- Included pts aged 20-80+ years at 30 veterans affair centers and two university dental clinics.
- Alveolar ridges ranged from normal to resorbed with intact basal bone.
- Osteotomies were prepped according to manufacturer protocol

- Direct measurements taken of residual facial bone thickness, 0.5 mm below bone crest
- Distance top of DIs to facial bone crest measured w perio probes.
- DIs uncovered after 3-4 months in mand and 6-8 months in max
- Facial bone response: difference btwn facial bone height at insertion/stage 1 and uncovery/stage

Results:
- Total of 2,685 DIs
- Mean F bone thickness after osteotomies: 1.7mm.
- When mean F bone thickness was 1.8+mm, bone apposition more likely to occur.
- Mean F bone response: −0.7mm.
    - DIs integrated at stage 2: −0.7mm
    - DIs mobile at stage 2: −2.8mm
- Bone responses similar for HA-coated and non–HA-coated DIs
    - Bone loss w HA DIs slightly less (0.7 vs 0.8mm)

Conclusions:
- NSSD for bone thickness and bone loss for the two groups
- NSSD for various F bone thicknesses and DI survival at uncovery
- NSSD in amount of F bone loss for various bone qualities
- Largest bone loss occurred when F bone thickness at placement ranged <1-1.4mm.
    - As thickness incr 1.4-1.7mm, bone loss decr
    - As thickness incr to 1.8mm, loss decr or had no change; possibility of bone gain incr.
- Suggests “critical thickness” to reduce facial bone loss is ~2 mm
- F bone loss did not sig differ btwn HA- and non–HA-coated DIs

Facial Bone Thickness Intervals by Survival Status

	Facial Bone Thickness (mm)					
	<1		1 - 2		>2	
Survival Status	N	%	N	%	N	%
Surviving	502	97.0	1,215	96.7	1,271	97.5
Failed	15	3.0	41	3.3	32	2.5
Total	517	100.0	1,256	100.0	1,303	100.0

Topic: Buccal Bone Wall Thickness
Authors: Monje A.
Title: The Critical Peri-implant Buccal Bone Wall Thickness Revisited: An Experimental Study in the Beagle Dog.
Source: Int J Oral Maxillofac Implants 2019 November/December;34(6):1328–1336.
DOI: 10.11607/jomi.7657
Type: Experimental Study
Reviewer: Brook Thibodeaux
Keywords: alveolar bone, dental implants, diagnostic, implant stability, peri-implant mucositis, peri-implantitis

Purpose: To analyze the influence of peri-implant buccal bone thickness on post sx physiologic bone loss and pathologic bone loss caused by ligature induced peri-implantitis model with spontaneous progression phase.

Methods:

- Randomized two arm study in vivo in healthy beagle dogs - first group of beagle dogs sacrificed 8 weeks after implant placement; second group was monitored during three ligature-induced peri-implantitis episodes and a spontaneous progression episode to explore the influence of critical buccal bone thickness in relation to pathologic bone loss.
- Protocol: Mandibular premolar/molars extracted, implants placed 8weeks later, 2 types on implants tested (rough to the top= R, 1.5m machined collar= H), after 8 weeks of healing the silk ligatures were placed and changed 3 weeks apart for a total of 3 events (t1-t3) ligatures removed after 3 weeks and lack of oral hygiene continued (T4).
- histological examination, radiographic analysis, statistical analysis.
- 72 DIs placed, 12 dogs included; Two groups: thin buccal bone wall- 36 DIs (tbb < 1.5 mm) and thick buccal bone wall- 36 DIs(TBB ≥ 1.5 mm).

Results:

- No DIs failed suring the study period- influence of critical buccal bone wall thickness upon DI survival was null
- Physiologic bone loss studied in dogs sacrificed 8wks after implant placement was studied
  - critical threshold to prevention excessive postsurgical buccal bone loss = 1.5mm.
  - Strong SS demonstrated for all parameters, except BIC.
- Critical buccal bone wall thickness in relation to pathologic bone loss studied in the dogs sacrificed post three episodes of ligature- induced peri-implantitis followed by an episode of spontaneous progression.
  - critical threshold to prevention excessive pathologic buccal bone loss= 1.5mm
  - Strong SS demonstrated for all parameters except internal lingual bone loss
- BOP, suppuration, and recession were all SS incr with thin buccal bone
- Hybrid implants (machined collar) experienced more L bone loss in the thin buccal bone group
- Sensitivity for prediction of physiologic bone resorption = 100%, specificity= 94.1% for linear one loss from implant shoulder to most coronal point of bone to implant contact when critical buccal bone thickness was set at 1.5mm
- For prediction of physiological bone resorption was 100% and specificity was 94.1%, for linear bone loss from implant shoulder to most coronal point of bone to implant contact when the B bone thickness was set at 1.5mm. For prediction of pathological bone resorption, sensitivity was 77.8% and specificity was 88.9% for linear bone loss from implant shoulder to most coronal point of bone to implant contact when B bone thickness was set 1.5
- Suppuration (+) and mucosal recession (-) were more often associated with implants placed in sites with a thin buccal bone wall.

Discussion:

- Rationale for vertical bone loss around DIs placed with a thin buccal wall (<1.5mm): A. 8 week healing period is mediated by avascular necrosis. In a healed ridge- the alveolar process is predom composed of cortical bone and the central portion is more cancellous. Cortical bone receives blood supply outside through blood vessels of the periosteum and on the endosteum through the endosteum. With open flap procedure implant insertion, blood supply from both sources are disrupted- elevation of periosteum eliminates that supply and insertion of the implant interrupts the endosteal blood supply. Within 12h of interruption the hematopoietic cells die. This leads to death of osteocytes and osteoblasts causing more noticeable osteoclast activity. Due to this, implants placed <1.5mm from the buccal bone flange may not have blood supply sufficient to repair the bone. Osteoclast activation by RANK/RANKL pathway (mediated by transcription factor- nuclear factor of activated T cells) cause B bone resorption in response. And B. thicker buccal bone wall >1.5mm provides protective mechanisms against progression of peri-implantitis

Conclusion: A critical buccal bone wall thickness of 1.5 mm at post implant placement is needed to minimize physiologic and pathologic bone resorption. Buccal bone thickness of >1.5mm proves to be more efficient in dimensional change compensation after implant placement. Survival rate does not appear to be influenced by critical buccal bone thickness.

Topic: bone augmentation
Authors: Quirynen M, Lahoud P, Teughels W, Cortellini S, Dhondt R, Jacobs R, Temmerman A.
Title: Individual "alveolar phenotype" limits dimensions of lateral bone augmentation

Source: J Clin Periodontol. 2022 Dec 27
DOI: 10.1111/jcpe.13764
Reviewer: Amber Kreko
Type: clinical study
Keywords: alveolar bone, alveolar crest dimensions, bone augmentation, bone resorption, graft resorption, guided bone regeneration, lateral bone augmentation, vertical bone augmentation.

Purpose: To evaluate the volume stability of lateral augmentation using 3D virtual reconstruction and superimposition of cone-beam CT (CBCT) data, with the contra-lateral ridge dimensions as reference.

Material and methods:
- 17 patients who had 23 GBR with following criteria: symmetrical maxillary arch, presence of intact contra-lateral site, CBCT before GBR, CBCT immediately after GBR, CBCT 6-8 months after GBR.
- Bone dimensions on contra-lateral non grafted site represented the "individual phenotypical dimension (IPD) of the alveolar crest." It was superimposed on augmented site and early (during graft healing) and late (during follow-up) graft resorption could be measured over time.
- Measurements were done in two dimensions, per mm apically from alveolar crest in center of GBR and in three dimesnions, 2mm away from M, D, and apical border.
- 12 GBR on bounded edentulous zones, 7 on single tooth span, 4 posterior to a last tooth. 19 performed with L-PRF bone block (50/50 mix of L-PRF with xenograft – Bio-)ss) and 4 with composite bone block (50/50 mix of xenograft with autogenous bone chips)
- Group A: evaluated early graft resorption
- Group B: evaluated early and late graft resorption together
- Group C: evaluated early and late graft resorption separately

Results:
- Group A: mean initial horizontal bone gain was 5.0mm with a mean of 2.0 *outside* the IPD and shrank to mean 3.7mm with 0.7mm being *outside* the IPD
- Group B: mean initial horizontal bone gain was 4.7mm with 2.1mm being *outside* the IPD. At 18 months, augmentations shrank to 2.4mm with 0.2mm *inside* the IPD
- Group C: mean initial horizontal bone gain was 4.8mm with 2.1mm *outside* the IPD; at 6-8 months, the graft shrank to 3.8mm with 1.0mm being *outside* the IPD; at 1 year later, gain was 2.5mm with 0.3mm *inside* the IPD.

Conclusions: The results showed that after early graft resorption, the outline of the augmentation was in general located 1mm outside the IPD but after 1.5 years, it further moved towards the IPD. IPD of the bony envelope may be a predictor of how much buccally one can regenerate bone when applying a GBR concept.

Topic: Lateral Ridge Augmentation
Authors: Elnayef B, Porta C, Suárez-López Del Amo F, Mordini L, Gargallo-Albiol J, Hernández-Alfaro F
Title: The Fate of Lateral Ridge Augmentation: A Systematic Review and Meta-Analysis.
Source: Int J Oral Maxillofac Implants. 2018 May/Jun;33(3):622-635
DOI: 10.11607/jomi.6290
Reviewer: Tam Vu
Type: Systematic Review and Meta-Analysis
Keywords: lateral ridge augmentation, bone graft, block graft, guided bone regeneration, bone gain, resorption

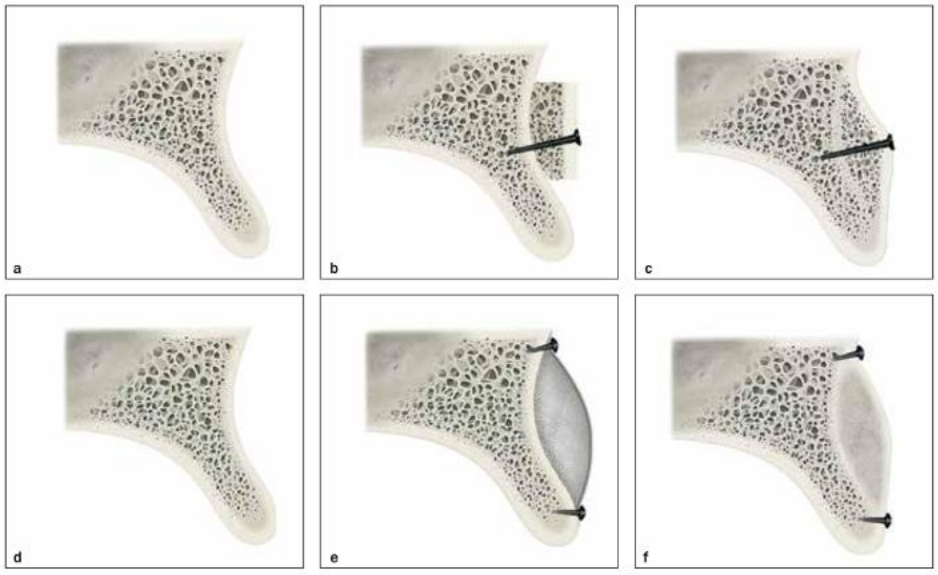
Purpose: to review horizontal ridge augmentation procedures and its stability over time

Material and methods: electronic and manual literature search through Feb 2017.
Population: partially edentulous pts w/mod/severe horizontal alveolar atrophy
Intervention: regenerative procedures for horizontal bone augmentation
Comparison: diff regen tx (GBR, auto block grafts)

Outcomes: total bone gain, bone resorption, implant survival

Results:

- 15 studies included
- Initial bone **gain** (mean): 3.71 mm
  - Block graft technique: 4.18 mm
  - GBR: 3.61 mm
- Final bone gain: 2.86 mm
  - Block graft: 4.03 mm
  - GBR: 2.59 mm
- Mean **resorption** after 6 mo: 1.13 mm
  - Block graft: 0.75 mm
  - GBR: 1.22 mm
- Implant survival rate: 97 – 100%
- Materials compared: autograft, auto+xeno, alloplast, xeno
  - Most gain with auto+xeno



Conclusion:

- No diff in mean bone gain among diff regenerative techniques
  - Block grafts maintain more volume compared to GBR
- The Fate of Lateral Ridge Augmentation is GRAFT RESORPTION
  - Regardless of material, graft resorption always occur -- always overcompensate/overgraft to counteract resorption

Topic: Need RG and Limitations
Authors: Jiang X, Zhang Y, Di P, Lin Y.
Title: Hard tissue volume stability of guided bone regeneration during the healing stage in the anterior maxilla: A clinical and radiographic study.
Source: Clin Implant Dent Relat Res. 2018 Feb;20(1):68-75
DOI: 10.1111/cid.12570
Reviewer: Daeoo Lee
Type: RCT
Keywords: alveolar bone regeneration; bone substitute; clinical study; cone-beam CT; instability; tissue pressure.

Purpose: To evaluate the volume stability of hard tissue augmented with particulate bone graft (DBBM) and collagen membrane during the healing stage of GBR, in transmucosal (test) and submerged (control) groups, utilizing the three-dimensional virtual reconstruction and superimposition of cone-beam computed tomography (CBCT) data.

Material and methods:

- 28 pts, healthy periodontal condition with single incisor missing in maxilla for at least 6 mo.
- Surgical Procedure
- Prophylactic antibiotics (cefuroxime (cephalosporin) 0,25g) 1hr before; chlorhexidine pre-rinse.
    - Triangular full thickness flap
    - Implant (Ankylos, Dentsply implants,) shoulder was placed approximately 5 mm below the gingival margin of the neighboring teeth and 1–2 mm below the alveolar ridge
    - GBR using DBBM (Bio-Oss) and resorbable collagen membrane (Bio-Glide)
    - At least 2 titanium fixation pins used
    - Test group: healing abutment was connected to the implant to facilitate transmucosal healing
    - Control group: submerged healing was achieved with primary soft tissue closure.
    - Post surgical antibiotics and analgesics, chlorhexidine, dexamethasone were prescribed.
- Radiographic evaluation
    - CBCT scanning was performed before surgery, immediately post-op, and 6 mo post-op.
    - Linear dimension of buccal bone analyzed
    - Alveolar ridge width analyzed
    - Boundary line connecting the most labially prominent point of the adjacent alveolar ridge analyzed in relation to the distances to hard tissue outlines analyzed.
- Statistical evaluation

Results:

- All 28 pts. completed study with 14/14 (test/control group)
- NSSD regarding horizontal bone parameters at 6 mo.
- SSD test group had more bone reduction vertically and Less New Bone Formation
- NSSD regarding alveolar ridge width at 6 mo.
- NSSD regarding distance from reference line at 6 mo.

Conclusions:
Transmucosal or submerged implant healing with GBR heals similarly.

Flap Management and Anatomy

Topic: Periosteal release technique
Authors: Ronda M. and Stacchi C.
Title: A Novel Approach for the Coronal Advancement of the Buccal Flap
Source: Int J Periodontics Restorative Dent. 2015 Nov-Dec;35(6):795-801.
DOI: 10.11607/prd.2232
Reviewer: Cyrus J Mansouri
Type: Case series
Keywords: buccal flap, periosteal release, grafting, vertical augmentation, guided bone regeneration

Background:
Adequate flap release is necessary to perform a tension-free closure over an augmented area. In the posterior mandible, the use of conventional periosteal incisions are often limited by anatomical factors.

Purpose:
To introduce a novel surgical technique to enhance the coronal advancement of the buccal flap in a safe and predictable way when performing vertical guided bone regeneration in the posterior mandible.

Material and methods:

64 consecutive pts in need of dental implants and associated bone augmentation procedures were enrolled.

- 49 women and 15 men.
- 11 light smokers and 53 nonsmokers.
- Inclusion criteria were mandibular partial edentulism (Kennedy class I or II) and residual ridge height < 7 mm coronal to the mandibular canal.

Surgical protocol:

- Perioral skin disinfected using iodopovidone 10% and oral rinse with chlorhexidine mouthwash 0.2%.
- Full thickness crestal incision was made in keratinized tissue, from the retromolar pad to the distal surface of the most distal tooth. The incision continued in the mandibular ramus for 1 cm, finishing with a vertical releasing incision on its anterior surface.
- To preserve the lingual nerve, the blade was inclined approximately 45 degrees with the tip in the buccal direction and the external oblique ridge was used as a marker for the incision going distally and buccally.
- Mesially, the flap continued intrasulcularly for two teeth on the buccal with a vertical hockey-stick releasing incision and one tooth on the lingual with a incision continuing in the keratinized tissue another 1 cm.
- A full thickness flap was raised on the lingual by detaching the insertion of the mylohyoid muscle from the inner part of the flap using a blunt instrument. On the buccal the tissue was reflected to expose the entire defect. In the area of the mental foramen, the mental nerve was identified and carefully isolated.
- The buccal flap was then released using the following protocol:
    - Holding the flap in tension with an anatomical forceps, the periosteum was cut to a depth of 1 mm by moving a new 15 or 15c blade, without stopping, distal to mesial. The blade had to cut the tissue apically to the mucogingival junction to prevent flap perforation, and coronally to the vestibular fornix. This conventional PRI allowed for a coronal displacement of the flap, which was measured with a periodontal probe at three different points on the periosteal incision line.
    - Keeping the flap in tension, the blade was used with a brushing movement over the entire area to interrupt the residual periosteal fibers and to dissect and separate the superficial from the deeper part of the flap.

Fig 1 *Preoperative situation with a severe atrophy of the posterior mandible.*

Fig 2 *Elevation of a full-thickness flap to expose the entire defect. The mental nerve is identified and carefully isolated.*

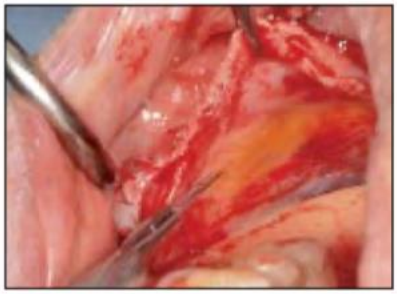


Fig 3 *The longitudinal periosteal releasing incision is made moving the blade perpendicular to the periosteum, without stopping, from distal to mesial.*

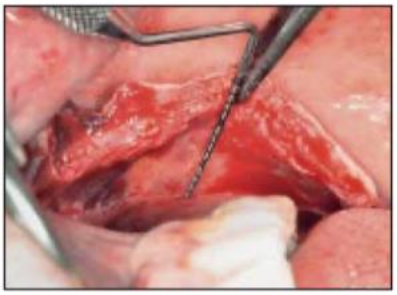


Fig 4 *The coronal displacement after PRI is measured with a periodontal probe in the mesial, central, and distal parts of the flap.*

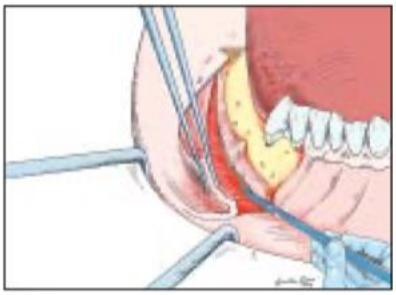


Fig 5 *Keeping the flap in tension, a brushing movement is performed with a new blade, dissecting and separating the superficial from the deeper part of the flap.*

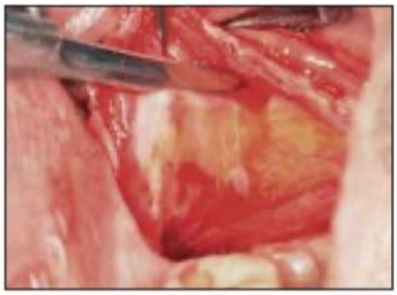


Fig 6 *The coronal displacement after the brushing is measured with a periodontal probe in the mesial, central, and distal parts of the flap.*

- The vertical augmentation was performed using Ti-d-PTFE and mineralized allograft (Puros). Implant sites were prepared using twist drilled and finalized with piezoelectric inserts over the mandibular canal.
- Implant fixtures were placed and left protruding from the original bone level for the desired amount of vertical regeneration.
- Cortical perforations were made and allograft was positioned with membrane adapted and fixed with fixation tacks.

Fig 7 (left) *Implants protrude from the bone level for the amount of vertical regeneration programmed.*

Fig 8 (right) *An allograft and a d-PTFE membrane are positioned around implants to reconstruct the defect.*

- Mucoperiosteal flaps were tested for adequate release to cover augmentation area without tension.
- A double line of closure was performed:

    - Horizontal mattress used first to favor close contact between CT.
    - Multiple single interrupted suture.
- AMX/Clauvalanate (875/125 mg) BID and Ibuprofen 600 mg BID were prescribed for 1 week, along with 0.2% CHX.
- Sutures removed 12-15 days after surgery and pt seen subsequently every 15 days to assess healing and verify wound closure.
- Membranes removed at 6-7 months and implants connected with healing abutments.

Fig 9 *The membrane is removed after 6 months and the implants appear covered by the newly formed hard tissue.*

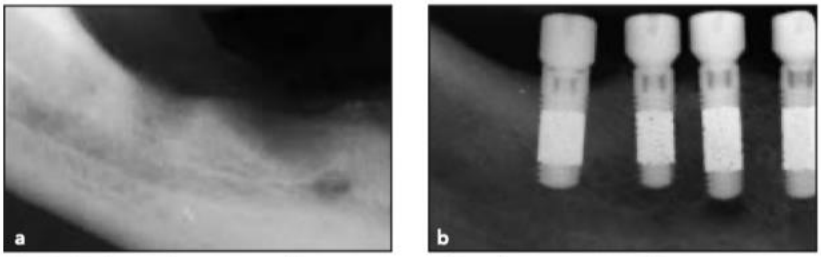


Fig 10 *Radiographic images of the preoperative* (a) *and postoperative* (b) *situations at membrane removal.*

Results:
76 mandibular sites were treated with 215 dental implants with contextual vertical GBR.
- All sites presented with class II vertical ridge deficiencies (>3 mm; Tinti & Parma-Benfenati classification).
- Coronal displacement of the buccal flap after PRI varied from 4-11 mm (mean 8.4 mm).
    - After additional release performed with the brushing technique, the buccal flap advancement varied from 10-38 mm (mean 21.7 mm; mean additional release of 13.2 mm).

Minor temporary neurological complications occurred in 3 cases.
- Transient paresthesia caused by stretching of the mental nerve fibers during flap management or edema compression on the mandibular nerve.
- Complete resolution of symptoms varied from 1-4 weeks.

Minor vascular complications also occurred in form of local edema or hematoma.
- This complication is expected with this technique due to periosteal incisions to create passivity of the flap.

The healing period was uneventful in 96.1% of sites.
- 1 small membrane exposure without purulent exudate occurred in a smoker after 18 weeks.
    - Treated with topical application of 0.2% CHX gel BOD.
    - Membrane removed at 22 weeks with a satisfactory regeneration.
- 1 membrane exposure with purulent exudate.
- 1 formation of an abscess in the regeneration area without exposure of the membrane was observed in two smoker patients at 2 months and 3 weeks.
    - Membranes, grafts, and implants were removed, and a local antibiotic wash was administered intra-operatively. Pts also prescribed systemic abx.

Out of 215 implants, 209 resulted in clinical osseointegration (97.2%).

Conclusion:
This case series describes a novel approach to increase the coronal advancement of the buccal flap in regenerative surgery. This approach resulted in a 97% maintenance of the primary closure over a dPTFE membrane over the healing period. The described brushing technique allows for a significant enhancement in the coronal displacement of the buccal flap with capacity for direct visual access.

Topic: Primary Closure
Author: Ronda M, Stacchi C.
Title: Management of a coronally advanced lingual flap in regenerative osseous surgery: a case series introducing a novel technique.

Source: Int J Periodontics Restorative Dent. 2011 Sep-Oct;31(5):505-13.
DOI: PMID: 21845245.
Type: Case Series
Reviewer: Veronica Xia
Keywords: vertical bone augmentation, primary closure, flap design, flap tension

Purpose:

- Present a novel technique for the coronal displacement of the lingual flap and review its clinical efficacy to obtain and maintain primary closure on the augmentation area

Materials and Methods:

- 52 patients needing dental implants in the posterior mandible
- Clinical and radiographic examination
- 69 sites in posterior mandible treated with insertion of dental implants associated with vertical bone augmentation
- Surgery
    - Full-thickness crestal incision from distal surface of distal tooth to retromolar pad, onto ramus for 1cm (releasing incision on lateral surface)
    - Intrasulcular incisions on buccal and lingual sides
        - Buccally it involved two teeth before finishing with a vertical hockey stick releasing incision
        - Lingually it involved one tooth to the gingival zenith and then continued horizontally in a mesial direction for 1cm in the KT
    - Releasing incisions made for entire length of flap and elevated until reaching the mylohyoid line
    - Blunt instrument used to localize CT band continuing with epimysium of the mylohyoid muscle à detached from lingual flap
    - Vertical augmentation performed with titanium-reinforced expanded PTFE and bone allograft/autograft
    - Implant placed and left to protrude to level of planned vertical regeneration
    - Cortical bone perforations
    - Flaps checked for passivity and coverage of augmented site
    - Horizontal mattress and interrupted sutures
    - Amoxicillin/clavulanate potassium (875+125mg) and ibuprofen (600mg) prescribed twice a day for 1 week
    - Post-op every 15 days à looking for primary closure (complete coverage of the membrane for at least 6 months after augmentation)
    - Membranes removed after six months

Results:

- Coronal displacement of flaps was observed in all sites
    - 4 sites showed signs of infection in augmented zone (swelling/purulence) during the first two weeks
        - Membranes/implants removed

Conclusion:

- Surgical technique based on separation of the lingual flap and underlying muscular structures in the molar area
- Primary closure was maintained in all cases (four cases of early infection likely a result of intra-operative contamination of the composite bone graft)

Topic: Flap management and anatomy
Authors: Urban I, Traxler H, Romero-Bustillos M, Farkasdi S, Bartee B, Baksa G, Avila-Ortiz G.
Title: Effectiveness of Two Different Lingual Flap Advancing Techniques for Vertical Bone Augmentation in the Posterior Mandible: A Comparative, Split-Mouth Cadaver Study
Source: Int J Periodontics Restorative Dent. 2018 Jan/Feb;38(1):35-40.
DOI: 10.11607/prd.3227.

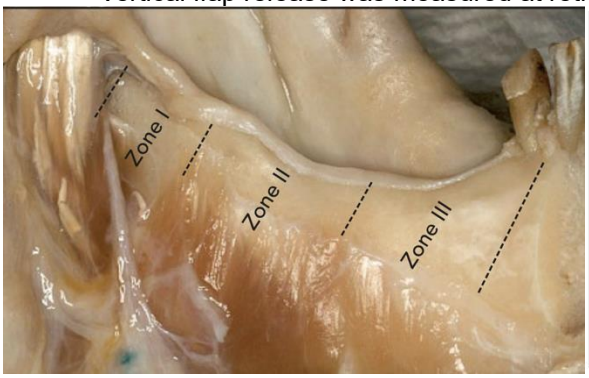
Type: Comparative Study
Reviewer: Trisha Nguyen-Luu
Keywords:
Background:

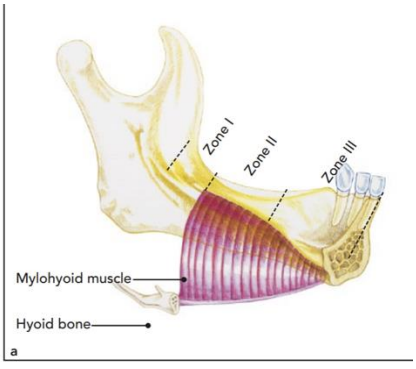
- Getting adequate flap release for primary wound closure during a vertical ridge augmentation in the posterior mandible may increase risk of lingual N, sublingual arteries + Wharton's duct
- Flap release required complete or partial detachment of mandibular insertion of mylohyoid muscle which may lead to post-op complications:
    - Primarily advancing middle portion of flap without including Zone I + Zone III
- Complete detachment may lead to:
    - Disruption of diaphragm of FOM
    - Communcation btw surgical area + sublingual/ submandibular space --> severe complication if there is a post-op infection
- Partial detachment may lead to:
    - Excessive thinning of central aspect of flap
    - Exposure of graft to oral environment in early stages of healing

Purpose: to present a novel lingual flap advancement technique for passive flap closure of vertical ridge augmentations

Material and methods:

- 11 fresh cadaver heads with bilateral posterior mand edentulism were included in the split mouth study
- Control site: received classic lingual flap released technique
- Test site: Mylohyoid preservation technique
    - Zone I: tunneling + lifting of the retromolar pad
        - Periosteal instrument gently reflects retromolar pad from bone + pulls it up coronally
        - Incorporation of the retromolar pad into the lingual flap to max release + Reduce risk of perforation in Zone II/III
    - Zone II: Flap separation with mylohyoid muscle preservation
        - Visually identify mylohyoid muscle insertion
        - Soft tissue superior to muscle is pushed with blunt instruments in lingual direction – separate flap from superior fibers of muscle without detaching muscular insertion
    - Zone III: Anterior, semiblunt periosteal release
        - Reflect flap no deeper than in Zone II in the premolar region
        - Semiblunt periosteal incision via 15 blade at a rotated perpendibular angle
            - Sweeping motion from Zone III to Zone II to provide flexibility + prevent wound dehiscence
- Vertical flap release was measured at retromolar pad area, middle area + premolar area





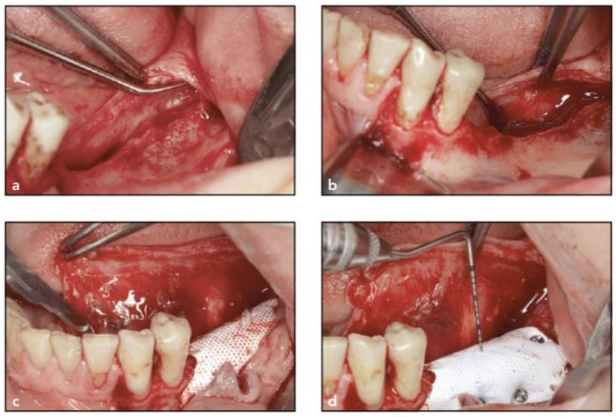


Fig 2 (a) *Elevation of the retromolar pad (zone I).* (b) *Careful elevation of the soft tissue located above the superior fibers of the mylohyoid muscle using a blunt instrument (zone II).* (c) *Semiblunt periosteal release using the back end of a number 15C blade on the anterior area of the flap (zone III).* (d) *Demonstration of vertical flap release (~20 mm).*

Results:

- Mean difference btw control + test:
  - Retromolar pad area: 8.273 mm
  - Middle area: 10.09 mm
  - Premolar area: 10.273 mm
- Test technique allowed for SS 8.2 more flap release in Zone I, 2.5 more flap release in Zone II, 5.3 more flap release in Zone III

Conclusions

- Mylohyoid preservation technique allowed for advancement of lingual flao more effectively than the classic flap management approach
- 2 major advantages:
  - Increase chance of achieving passive primary stability + avoiding premature wound dehiscences
  - Decrease risk of medical complications involving deeper anatomical spaces

Topic: mandibular anatomy
Authors: Urban IA, Monje A, Wang HL, Lozada J, Gerber G, Baksa G
Title: Mandibular regional anatomical landmarks and clinical implications for ridge augmentation
Source: Int J Periodontics Restorative Dent 2017;37: 347–353
DOI: 10.11607/prd.3199
Type: human cadavers
Reviewer: Erin Schwoegl

Purpose: To review structures of post mand region implicated in procedures in the atrophic mandible
Methods: Dissected 10 human cadaver heads
Results:
Musculature of FOM and tongue:

- Mylohyoid: creates the diaphragm of the mouth
  - originates from mylohyoid line of the mandible and inserts into the body of the hyoid bone
  - Swallowing, mouth opening, separation for the floor of the mouth
- Muscle involved with tongue movement: Genioglossus, hyoglossus, styloglossus, palatoglossus muscle
- Lateral lingual groove: groove between the mylohyoid and hyoglossus muscle
- Digastric muscle: anterior and posterior belly inserting into the hyoid bone
  - Posterior belly originates from mastoid notch of temporal bone
  - Anterior belly originates from digastric notch at mandibular symphysis
  - Mouth opening and lowering of mandible
  - Submandibular Triangle: digastric muscle body of the mandible
- Stylohyoideus m: originates from styloid process and inserts into hyoid bone

Vasculature: Arterial supply are provided by the branches of the external carotid artery

- Lingual artery:

    - Coursing anteriorly and superiorly, it eventually bifurcates becoming:
        - Deep lingual artery
        - Sublingual artery runs between the mylohyoid and the genioglossus muscles
            - provides branches to the sublingual gland, gingiva
            - most cases anastomose anteriorly with the submental artery.
            - Some terminal branches can penetrate the cortical bone.
- Facial artery
    - Reaches the base of the mandible superior to the submandibular gland and then curves up and courses in front of the masseter muscle toward the medial aspect of the eye.
    - Branches into the submental artery before the mandible and with runs towards the chin
    - 29% of cases: gives rise to a branch that perforates the mylohyoid muscle and anastomoses with the sublingual artery.

Innervation

- Lingual n (branch of CN V3)- innerves the anterior 2/3 of tongue
    - nerve turns anteriorly in the 3rd molar region and 75% of cases, turns toward the lingual site at the first and second molar.
    - The distance between the nerve and second molar: 9.6 mm
    - The distance between the nerve and first molar: 13 mm
    - The distance between the nerve and second premolar 14.8mm
- Hypoglossal n (CN XII)
    - Provides motor function for the tongue
    - Enters deep into the lateral lingual groove and reaches the lateral border of the hyoglossus m.

Salivary glands

- Submandibular salivary gland: Gland protrudes into the lateral lingual groove
    - Duct: Wharton's duct
    - Is crossed by the lingual inferiorly and opens into the sublingual caruncle
- Sublingual salivary gland
    - Duct: Sublingual duct of Bartholin
    - In the anterior portion of the lateral lingual groove and protrudes laterally from the lingual frenulum into the oral cavity as the sublingual fold

Potential complications

- Most common: hemorrhage, nerve damage, injury to neighboring structures
- 70% of mandibles (U-type ridge) have a concavity -> possible to perforate the lingual cortical plate during implant placement.
- Perforation can lead to excessive hemorrhaging (life threatening) because of the proximity of vasculature sublingual and submental arteries) on the inner aspect of the posterior mandible.
- Caution during implant placement and lingual flap reflection must be done

Clinical implications

- Blunt dissection with a dull instrument
    - In the atrophic anterior mandible, blunt dissection must never extend beyond the genial foramina - branches of the lingual artery and nerve could be injured.
- Applying compression to detach the mylohyoid muscle from the mandible or the mucosa overlaying the FOM.
- all-important landmarks were embedded within a very dense, fibrous CT compartment.
    - Supportive CT layer may prevent irreversible deep injury.

Topic: Vestibular Shifted Flap
Authors: De Stavola L, Tunkel J, Fincato A, Fistarol F.
Title: The Vestibular Shifted Flap Design for Vertical Bone Augmentation in the Maxilla: Case Report and Technical Notes.
Source: Int J Periodontics Restorative Dent. 2021 May-Jun;41(3):367-373.
DOI: 10.11607/prd.4471.
Type: Case Report
Reviewer: Brook Thibodeaux

Keywords:

Purpose: To describe an incision design which improves palatal flap management in the maxilla allowing for better wound seal and primary closure

Discussion:

- Wound dehiscence happens frequently- 12% horiz aug, 42% vert aug; soft tissue management is the factor that influences reconstruction outcome
- Two suture lines are needed for primary closure- horizontal suture to allow for 4-5mm of the flap inner faces to be coupled to each other (flap eversion) and single simple sutures.
- Flaps should be advanced until they are elongated 4-5mm coronal to the bone graft level.
- Incision design: Defect's M (A) and D (B)bone peaks represent the goal for vertical augmentation. The linear measurement between the bottom of the defect (C) and the line connecting M/D bone peaks defines the dimension of vertical deficiency in mm. (D) is the starting point to measure the required palatal flap length. To obtain a palatal flap 4mm longer than the graft level the crestal incision has to be shifted 4mm to the vestibular side (E). D to E should be vertical defect dimension + 4mm.

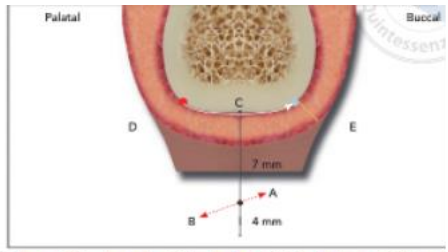


Fig 3 *Schematic cross-sectional view of the vertical defect at point C (maximum vertical deficiency); the red dotted line indicates the target of the vertical augmentation. A = bone peak mesial to the defect; B = bone peak distal to the defect; D = defect base on the palatal side (red dot); E = vestibular shifted incision line to obtain a palatal flap length of 7 + 4 mm long (blue dot/yellow line). The white arrow represents the shift toward the vestibular side.*

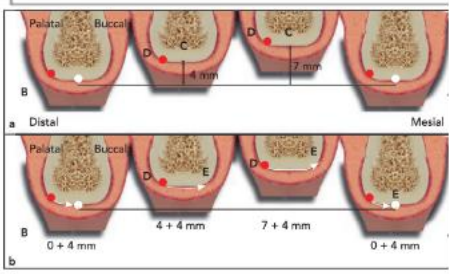


Fig 4 *Four schematic cross-sectional views of the vertical defect, from the distal (left) to the mesial (right) sides. (a) Note the different needs in vertical bone augmentation from the distal bone peak (B) to the mesial bone peak (A), related to the defect anatomy. C = point of maximum vertical deficiency in each cross-section; D = defect base on the palatal side in each cross-section (red dot). (b) Different vertical dimensions among the defect generate different needs for vestibular shifting of the incision line (E [yellow line]). The white arrows represent the shift toward the vestibular side (0 + 4 mm, 4 + 4 mm, 7 + 4 mm, 0 + 4 mm, respectively; the first number is the defect vertical dimension at that point; the second number is the is the standard 4-mm tissue needed to perform optimal mattress sutures). The black line represents the bone augmentation target.*

- Case: Maximum vert defect= 7mm, incision shift 11mm (7mm+4mm) from the palatal rim of the alveolar crest.

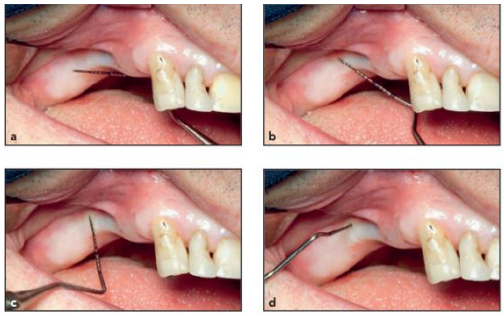


Fig 5 *Clinical view of the 7-mm vertical defect. A periodontal probe is used to transfer the 11-mm vestibularly shifted incision (7 + 4 mm) from the palatal base of the defect (point D). (a) The 11-mm tag of the probe is placed on point D. (b and c) The probe is then rotated on the vestibular side, maintaining contact with the gingiva. (d) The position reached by the tip of the probe corresponds to point E, the position of the shifted incision on the vestibular side.*

Fig 6 *The incision line is progressively and proportionally shifted on the vestibular side: (a) from the distal bone peak (where no defect is present), (b) through the maximum vertical defect area, where the incision is maximally shifted on the vestibular side, and (c) finally runs along on the vestibular third of the crest (on the area of the mesial bone peak). Note the 90-degree inclination of the blade in relation to the gingiva/bone. (d) A mesial releasing incision is performed at the first tooth mesial to the defect.*

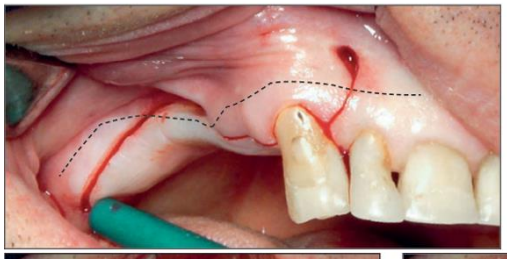


Fig 7 *Relationship between mucogingival junction* (black dotted line) *and the visible incision line. Note that the incision crosses the mucogingival junction for a short mesiodistal span in correspondence to the maximum vestibular shifting.*

Fig 8 (a) *Clinical view after palatal and vestibule flap elevation. Note the coronal position reached by the palatal flap in relation to the vertical defect.* (b) *The tissue extends about 4 mm beyond the target of the vertical bone augmentation (the line between A and B). A = mesial bone peak; B = distal bone peak; C = point of maximum vertical deficiency (7 mm).*

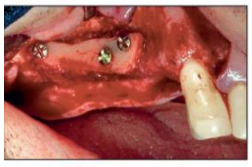


Fig 9 *Clinical view after vertical autogenous bone graft augmentation following the Khoury approach. Note the palatal flap position, which shows about 4 mm of the inner face coronal to the graft. This area will be placed again in the inner face of the vestibule flap to generate an optimal wound seal.*

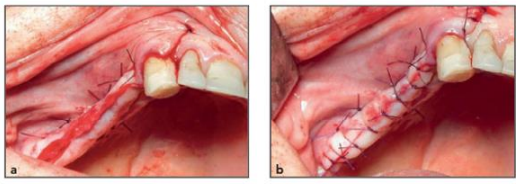


Fig 10 *Primary wound closure is obtained by applying* (a) *a horizontal mattress suture line 4 mm apical to the flap rims and* (b) *a simple suture line on the surface.*

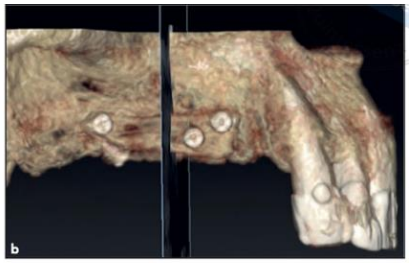


Fig 11 (a) *Clinical vestibular view immediately postoperative. Note the wound position is on the middle of the reconstructed crest, while the starting incision line was shifted to the vestibular side.* (b) *A CBCT scan taken immediately postoperative shows the alignment of the graft to the mesial and distal bone peaks.*

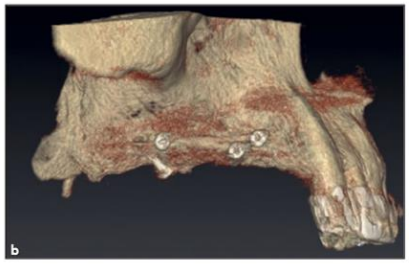


Fig 12 (a) *Clinical vestibular view after 4 months of healing.* (b) *A CBCT scan taken 4 months postoperative shows the alignment of the augmented area to the mesial and distal bone peaks before implant placement.*

Incision is at a 90 degree orientation. Where no defect is present, the incision will be on the vestibular 3rd of the alveolar crest. The vertical releasing incision is created M to the 1st/2nd tooth M to the defect. Full thickness palatal flap is positioned 4mm above the line connecting the M/D bony peaks. Horizontal sutures and single interrupted sutures utilized.

Conclusions: The proportionally vestibular shift incision can be used to simplify the management of the palatal flap during vertical bone augmentation.

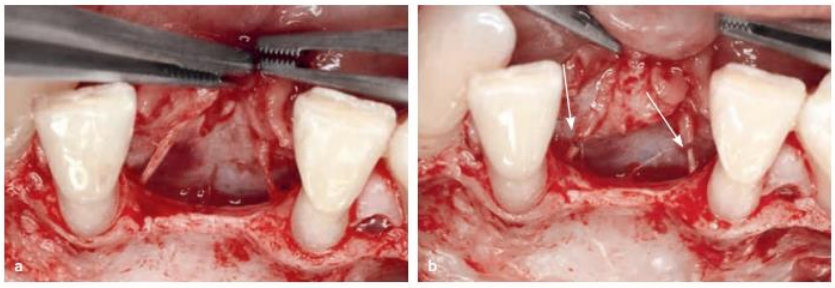
Topic: vertical augmentation
Authors: Urban IA, Saleh MHA, Serroni M, Shahbazi A, Baksa G, Szoke P, Ravid
Title: A Management of the Lingual Flap During Vertical Augmentation of the Atrophic Anterior Mandible: Anatomical Overview and Description of the Technique
Source: .Int J Periodontics Restorative Dent. 2024;44(1):17-25
DOI: 10.11607/prd.6667
Reviewer: Amber Kreko
Type: discussion
Keywords:

Purpose: To provide an anatomical overview of the lingual portion of the anterior mandible and provde a description of a novel surgical approach for release of the lingual flap that will help clinicians achieve primary closure without incurring intrasurgical complications

Discussion:
Anatomical Description

- Lingual artery – arises from external carotid at tip of greater horn of hyoid bone. Often has common origin with facial artery just beyond it and termed lingual-facial trunk
    - In first section, runs anteriorly almost parallel to hyoid bone and deep to posterior belly of the digastric and stylohyoid muscles, detaching the slander syprahyoid muscles which supplies the hyoid muscles
    - After it moves forward and deep between middle constrictor muscle of the pharynx and hypoglossal muscle which laterally separates it from the hypoglossal nerve, lingual vein, and submandibular glad.
    - In last section, it turns sharply upward to reach the space between genioglossus muscle and the langitudinal muscle of the tongue then folds back in the horizontal plane to reach the tip of the tongue (deep Lingual artery)

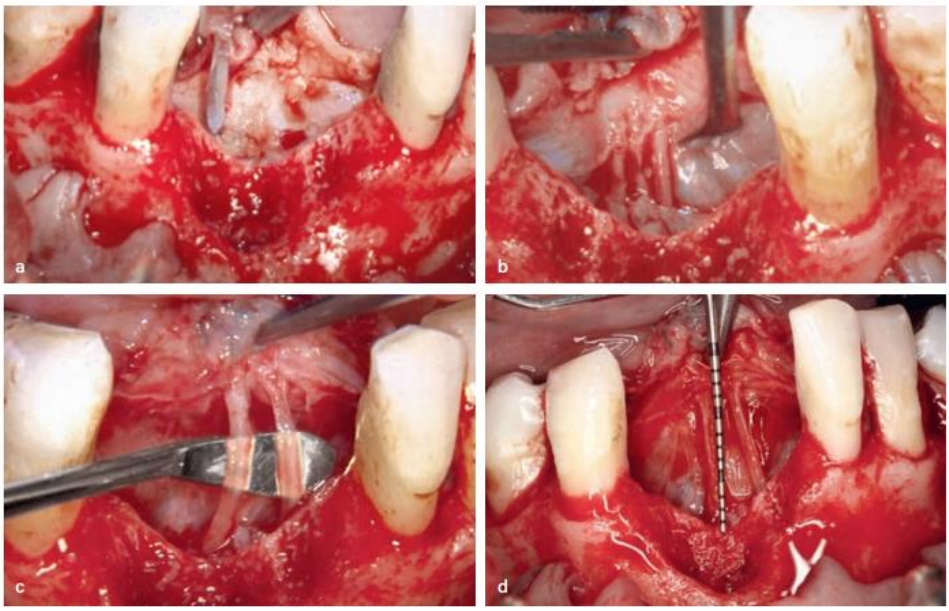
- The lingual artery gives rise to sublingual branch of the lingual artery (SUA) which is the arterial blood supply to the anterior hemiregions of the floor of the mouth.
- Lingual or supraspinous foramen is found in 99% of cases in midline of posterior aspect of mandibular symphysis. A small artery passes through resulting from union of the two branches. Other lateral accessory foramina may be present.
- In rare cases, two small terminal branches of SUA may enter foramina on lingual cortical plate in region of the lateral incisors, close to alveolar ridge.



▲ **Fig 2** Preliminary incisions and vessel ligation. *(a)* Upon lingual incisions, the SUA penetrating osseous vessels was identified during early phases of flap elevation. *(b)* Resorbable sutures (6-0 and 7-0) were used for ligation of the SUA branches penetrating the bone (*arrows*).

Presentation of the technique

- Lingual Flap
  - Step 1: preliminary incisions and flap reflection – short vertical incisions at the angle of the distolingual line of the teeth. Lingual flap is raised until sublingual foramen is identifies without going beyond insertion of the genioglossus muscle (Fig 2a)
    - When SUA vessels penetrating posterior surface of manibule, improtant to isolate and ligate. Periosteum should be completely intact after flap elevation, as terminal braches run superficially within deeper dense CT (Fig 2b)
  - Step 2: Semi-blunt periosteal incision -
    - First horizontal periosteal incision with tip of blade is preformed – resembles double-ended hockey stick" Should involve the periosteum and act as a door opener to underlying CT (Fig 3a)
    - Next, semi-blunt insicion made using back end of a no.15 blade. Blade plate in not perpendicular to flap, but rotated 90 degrees using seeping motion technique (Fig 3b). Terminal branches of SUA protruding from underlying, dense CT should be identified.
  - Step 3: lingual flap advancement – small elevator inserted in periosteal incision line (Fig 3c) and exposed dense CT is stretched with a coronal pushing motion (Fig3d).



▲ **Fig 3** Incisions and flap reflection, release, and advancement. *(a)* Labial view of the periosteal incision made with the back end of the blade, exposing the underlying dense connective tissue. *(b)* Initial identification of SUA bundles protruding from the underlying dense connective tissue. *(c)* Insertion of a small periosteal elevator (Mini Me, Hu-Friedy) to stretch the tissue. *(d)* Final stage of advancement, with a labial view of the final stretch after safe preparation of the arteries.

- Buccal Flap – using a surgical scalpel, full thickness midcrestal incision in made in KG and 2 vertical releasing incisions are placed distally within the buccal flap preferably two teeth beyond the surgical site. Identify mental nerve before verticals. Full thickness flap 5mm beyond bony defect.
- Flap Closure – eversion of wound margins with overlap at least 5mm wide. Double layer of sutures: first is horizontal mattress sutures placed 5mm from incision line and single interupted suture placed close to the edge of the flap.

Conclusions: Anatomical knowledge of anterior mandible and proper technique are essential for safe and effective vertical regeneration.

Topic: Lingual artery
Authors: Shahbazi A, Windisch P, Tubbs RS, Decater T, Urbán IA, Baksa G, Iwanaga J.I
Title: The Clinical Relevance of the Lingual Branch in Ridge Augmentation of the Posterior Mandible: A Pilot Cadaver Study.
Source: Int J Periodontics Restorative Dent. 2024 Mar 20;44(2):213-218
DOI:10.11607/prd.6458
Reviewer: Tam Vu
Type: Clinical (Cadaver study)
Keywords: lingual branch, inferior alveolar artery, maxillary artery, lingual nerve, ridge augmentation, flap mobilization, vascularization

Purpose: to review the anatomical and clinical relevance of the **lingual branch** of the inferior alveolar/maxillary arteries in the posterior lingual aspect of the mandible during ridge aug and flap mobilization

Material and methods: 12 edentulous hemimandibles from 6 human cadavers, corrosion casting and latex injection to prepare the specimens. Neurovascular bundle above the mylohyoid was analyzed and measured

Results:

- 2 different of lingual branch were identified: type I and II (type II categorized as II/a or II/b)

Lingual branch	Origin	
Type I	originate directly from inferior alveolar artery [4 – 12 mm above mandibular lingula]	Lingual br have communicating br to retromolar foramen, and travels horizontally in vicinity of alveolar ridge
Type II/a	Originate from **medial pterygoid br** (br of maxillary artery)[8 – 13 mm above mandibular lingula]	Supplies lateral and medial pterygoid muscles
Type II/b	Originate directly from common trunk arising from **maxillary artery** [22 mm above mandibular lingula	

▲ **Fig 1** Demonstration of a type I LB (corrosion casting). *(a)* Overview of the arterial supply above and below the mylohyoid line at the posterior lingual aspect of the mandible. FA = facial artery. *(b)* Medial view of the mandibular ramus, showing the course of the LB and MB originating directly from the IAA. *(c)* The LB runs parallel with the alveolar ridge in the vicinity of the periosteal ridge, providing a communicating branch to the retromolar foramen *(arrow)*.

- Lingual br was detected in a common connective tissue sheath with the lingual nerve, anterolateral to the medial pterygoid muscle
    - Lingual br was located laterally and lingual n located medially on all sides -- acted as **anatomical landmark to identify lingual n** in posterior lingual aspect of mandible
- Lingual br blood supply for
    - lingual n.
    - superior aspect of alveolar mucosa and crest
- Surgical considerations
    - Dissecting toward floor of mouth penetrates muscular sub-branches of submental artery
        - Supplies deep portion of periosteum in posterior lingual aspect above mylohyoid m and located lateral to lingual br
    - Deeper dissection for flap mobilization for extensive bone augmentation -- facial artery identified,
        - Supplies mylohyoid m, periosteum, and lingual n in posterior aspect of submandibular gland
    - Blunt dissections w/out extending to retromolar area recommended to conserve neurovasculature

Conclusion: Perception and locating the lingual branch may prevent neurovascular damage during lingual flap design in ridge aug and cause less postop morbidity.